performed by a thermo-regulator. On the other hand, in apparatus heated by coal or coke the temperature continually tends to vary, and can only be maintained uniform by constant attention on the part of the stoker.

In very few hot-air chambers did the thermometer with which the apparatus was provided afford a trustworthy indication of the temperature of the interior; in some instances there was an error of as much as 100° F. This is due to the thermometer, for reasons of safety and accessibility, being placed in the coolest part of the chamber, and to the bulb being inclosed for protection in a metal tube which screens it from the full access of heat. The difficulty may be overcome by using, instead of a thermometer, a pyrometer actuated by a metal rod extending across the interior of the chamber.

In steam apparatus the three requirements above mentioned are all satisfactorily met, and for this reason, as well as on account of the greater rapidity and certainty of action of steam, both in penetrating badly conductive materials and in destroying contagia, steam chambers are, in Dr. Parsons's opinion, greatly preferable to those in which dry heat is employed.

It is important that the arrangements of the apparatus, the method of working, and the mode of conveyance to and fro, should be such as to obviate risk of articles which have been submitted to disinfection coming into contact with others which are infected.

The latter part of the Report is taken up with descriptions of the various forms of apparatus in use for disinfection by heat, and accounts of experiments made with a view to test their practical efficiency.

ON THE FRACTIONATION OF YTTRIA[1]

HAVING already explained the methods of chemical fractionation, it may be useful now to describe some of the results yielded by an extended perseverance in these operations.

I must, in the first place, explain that my work has been confined to a limited and very rare group of bodies—the earthy bases contained in such minerals as samarskite, gadolinite, &c. These have been repeatedly put through the fractionation mill by other chemists, but the results have been most unsatisfactory and contradictory, no sufficiently good test being known whereby the singleness of any earth got out by fractionation could be decided, except the somewhat untrustworthy one of the atomic weight. I say *untrustworthy*, because it is now known that fractionation, unless it is pushed far beyond the point to which some Continental chemists have even carried it, is quite as liable to give *mixtures* which refuse to split up under further treatment of the same kind, as it is to yield a chemically simple body. This I have fully gone into in my paper "On the Methods of Chemical Fractionation." The unsatisfactory nature of fractionation work may be seen from expressions used, in private letters to me, by some of the eminent chemists who have almost made this method their own. One writes—"It is very tiresome working with the rare earths, as we never can be sure when we have got a definite result. There will never be an end to their history. I am very tired of it, and am much inclined to give it up." Another writes—"Unfortunately I commenced my researches on the rare earths with too little material, and I have not had the courage, at my age, to recommence the work on more abundant material. The further I advance in my work the more I am convinced that no known method permits of the complete separation of these different earths one from the other." A third writes—"One loses so much material in the separations that it appears to me scarcely possible, with the material available, to arrive at a successful solution of the question." I could multiply similar quotations, all breathing the same almost despairing spirit.

It would certainly not have been prudent on my part to invite a time-honoured comparison, and "rush in" where so many eminent men "fear to tread," were it not that good fortune had placed in my hands a physical test for these obscure molecular groupings which is of the most exquisite sensitiveness. I refer to what I have for shortness called the Radiant-Matter test.

It is well known that a limited group of these rare earths, when phosphoresced *in vacuo*, yield discontinuous spectra. The method adopted to bring out the spectra is to treat the substance under examination with strong sulphuric acid, drive off excess of acid by heat, and finally to raise the temperature to dull redness. It is then put into a radiant-matter tube of the form shown in Fig. 1, and the induction spark is passed through it after the exhaustion has been pushed to the required degree. The phosphorescence occurs beneath the negative pole. As each gaseous molecule, carrying its charge of negative electricity with it, strikes the earthy sulphate, it has a tendency to part with its charge, provided it finds a body ready to take up the electricity; otherwise it retains its charge. Bodies like yttrium sulphate, &c., easily take the electric charge, and under the stimulus phosphoresce, emitting light whose waves tend to collect round definite centres of length. The phosphorescent light which the discharge evokes is best seen in a spectroscope of low dispersion, and with not too narrow a slit. In appearance the bands are more analogous to the absorption-bands seen in solutions of didymium than to the lines given by spark spectra. Examined with a high magnifying power, all appearance of sharpness generally disappears: the scale measurements must therefore be looked upon as approximate only; the centre of each band may be taken as accurately determined within the unavoidable errors of experiment, but it is impossible to define their edges with much precision. The bands are seen much sharper when the current first passes than after the current has been passing foı some time and the earth has become hot. On cooling, the sharpness of the bands re-appears.

As a general rule, the purer the earth the sharper the band, and when impurities are removed to the utmost extent, the sharpness is such as to deserve the name of a line. This may be illustrated by mixing together yttria and lime. Lime phosphoresces with a continuous and yttria with a discontinuous spectrum. Mixed together, the phosphorescing energy of the lime does not spend itself over the whole spectrum, but concentrates itself in greatly reinforcing the yttria bands. A molecule of yttria vibrating with a definite wave-length gives a nearly sharp line, but the molecule of lime with which it is weighted has no special tendency to vibrate to one wave-length more than another. The yttria induces the right vibration in the adjacent molecule of lime; but this lime, once set in vibration, cannot confine itself to the exact wave-length required, and overflows a little on each side, and the result is a widening and blurring of the bands, becoming greater in amount as the extraneous earth increases in quantity.

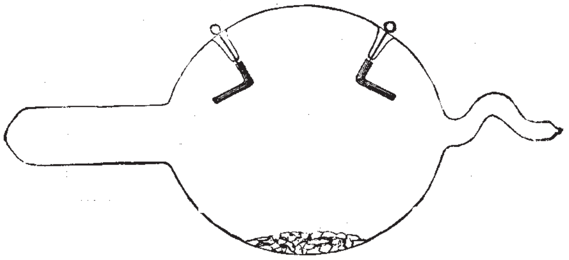

Fig. 1.

To this rule one exception occurs. The body which I have named Sδ, or 609, is remarkable for the great sharpness of its phosphorescent line, and I have noticed scarcely any variation in its sharpness, however large the bulk of extraneous earth associated with it. This line, however, is sharper and brighter when the current is first turned on than it is after the earth has been phosphorescing for a minute or so.

In the Bakerian lecture on yttrium delivered before the Royal Society (*Phil. Trans.* Part 3, 1883), I described the phosphorescent spectrum given by this element, and in the address which I have had the honour of delivering before this Section I gave a drawing of the spectrum of yttrium, together with a sketch of the train of reasoning by which I had been led to the opinion that excessive and systematic fractionation had split up this stable molecular group into its components, distributing its atoms into several groups, with different phosphorescent spectra.

No longer than twelve months ago the name yttria conveyed a perfectly definite meaning to all chemists. It meant the oxide of the elementary body yttrium. I have in my possession specimens of yttria from M. de Marignac (considered by him to be purer than any chemist had hitherto obtained), from M. Clève (called by him "purissimum"), from M. de Boisbaudran (a sample of which is described by this eminent chemist as "scarcely soiled by traces of other earths"), and also many specimens prepared by myself at different times and purified up to the highest degree known at the time of preparation. Practically these earths are all the same thing, and up to a year ago every living chemist would have described them as identical, *i.e.* as the oxide of the element yttrium. They are almost indistinguishable one from the other both physically and chemically, and they give the phosphorescent spectra *in vacuo* with extraordinary brilliancy. This is what I formerly called yttria, and have more recently called *old* yttria. Now these constituents of old yttrium are not *impurities* in yttrium any more than praseodymium and neodymium (assuming them really to be elementary) would be impurities in didymium. They constitute a veritable splitting up of the yttrium molecule into its constituents.

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[1] A Paper read before Section B of the British Association at the Birmingham meeting, by William Crookes, F.R.S., V.P.C.S

The plan adopted in the fractionation of yttria does not differ in principle from the methods described in my former paper "On the Methods of Chemical Fractionation." Dilute ammonia is added to a very dilute solution of the earth in only sufficient quantity to precipitate one half. After standing for several hours the precipitate is filtered. After each fractioning the filtrate is passed to the left and the precipitate to the right, and the operations are continued many thousand times.

The diagram (Fig. 2) shows the scheme clearly, with the direction the precipitates and solutions travel. Limited space, even on a large diagram, prevents me from giving more than a few operations, but they will be sufficient to satisfy you that enormous patience, a large amount of material, and a not insignificant number of bottles, are requisites for successful fractionation. Such proceedings are tedious enough even in their narration, but no mere words can enable any one to realise the wearisome character of these operations when repeated day by day, month after month, on long rows of Winchester quart bottles.

After a certain time, on examining the series of earths in the lowest line of bottles, their phosphorescent spectra are found to alter in the relative intensities of some of the lines, and ultimately different portions of the fractionated earths show spectra such as I have endeavoured to illustrate at the foot of the diagram (Fig. 2), where I give the spectra of five components of yttrium.

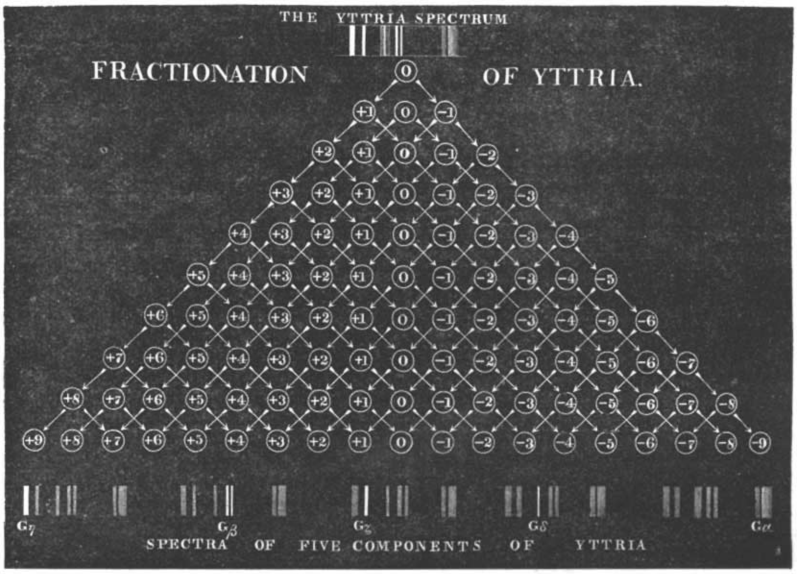

FIG. 2.

The final result to which I have come is that there are certainly five, and probably eight, constituents into which yttrium may be split. Taking the constituents in order of approximate basicity (the chemical analogue of refrangibility), the lowest earthy constituent gives a deep blue band, Gα (λ 482); then there is a strong citron band, Gδ (λ 574), which has increased in sharpness till it deserves to be called a line; then come a close pair of greenish-blue lines, Gβ (λ 549 and λ 541, mean 545); then a red band, Gζ (λ 619), then a deep red band, Gη (λ 647), next a yellow band, Gε (λ 597), then another green band, Gγ (λ 564); this (in samarskite and cerite yttria) is followed by the orange line Sδ (λ 609). The samarium bands remain at the highest part of the series. These, I am satisfied, are also separable, although for the present I have scarcely touched them, having my hands fully occupied with the more easily resolvable earths. The yellow band, Gε, and green band, Gγ, may in fact be due to a splitting up of samarium.

Until we know more about these bodies I refrain from naming them, but will designate them provisionally by the mean wavelength of the dominant band. If, however, for the sake of easier discussion among chemists a definite name is thought to be more convenient, I will follow the plan frequently adopted in such cases, and provisionally name these bodies as shown in the table given below.

The initial letters S and G recall the origin of the earths respectively from Samarskite and Gadolinite.

Not only has yttrium been split up by subjection to fractionation, but samarium, as I have hinted above, is likely to prove equally unable to resist this operation. In the phosphorescent spectrum of samarium sulphate the line Sδ (609) is one of the constituents. When yttria is added to samaria this line is developed in greater intensity, as yttria has the power of deadening the other bands of samarium, while it does not seem to affect the line Sδ. Several circumstances, however, tend to show that although line Sδ accompanies samarium with the utmost per-

Position of lines in the spectrum	Scale of spectroscope	Mean wave-length of line or band	$\frac{1}{\lambda^2}$	Provisional name	Probability
Bright lines in—					
Deep blue ...	8·931	482	4304	Gα	New
Greenish-blue (mean of a close pair...	9·650	545	3367	Gβ	New, or the Zβ of M. de Boisbaudran
Green....... ..	9·812	564	3144	Gγ	New
Citron	9·890	574	3035	Gδ	New, or the Zα of M. de Boisbaudran
Yellow.........	10·050	597	2806	Gε	New
Orange........	10·129	609	2693	Sδ	New
Red............	10·185	619	2611	Gζ	New
Deep red......	10·338	647	2389	Gη	New

tinacity, it is not so integral a part of its spectrum as the other red, green, and orange lines. For instance, the chemical as well as physical behaviour of these line-forming bodies is different. On closely comparing the spectra of specimens of samaria from different sources, line Sδ varies much in intensity, in some cases being strong and in others almost absent; the addition of yttria is found greatly to deaden the red, orange, and green lines of samarium, while yttria has little or no effect on the line Sδ; again, a little lime entirely suppresses line Sδ, while it brings out the samarium lines with increased vigour. Finally, attempts to separate line Sδ from samarium and those portions of the samarskite earths in which it chiefly concentrates has resulted in sufficient success to show me that, given time enough, and an almost inexhaustible supply of material, a separation would not be difficult. These facts, together with the peculiar behaviour of the lines Gε and Gγ, strengthen my suspicion as to the resolvability of samarium.

Samaria giving the line Sδ had been prepared from cerite and samarskite. Many observations had led me to think that the proportion of band-forming constituents varied slightly in the same earth from different minerals. Amongst others, gadolinite showed indications of such a differentiation, and therefore I continued the work on this mineral. Very few fractionations were necessary to show that the body giving line Sδ was not present in the gadolinite earths; no admixture of yttria and samaria from this source giving a trace of it. It follows, therefore, that the body whose phosphorescent spectrum gives line Sδ occurs in samarskite and cerite, but not in gadolinite.

It now became an interesting inquiry whether all these constituents of yttrium were united together in exactly the same proportion in every case. A glance at the diagram will show that yttrias from different sources, although they may be alike as far as our coarser chemical tests are concerned, are not built up exactly in the same manner. Thus, when the samarskite yttrium was forming, all the constituent molecules—which I have provisionally named Gα, Gβ, Gγ, Gδ, Gε, Gζ, Gη, and Sδ—condensed together in fair proportion. In gadolinite yttrium the constituents Gβ and Gδ are plentiful, Gζ is very deficient, Sδ is absent, and the others occur in moderate quantities. In the yttrium from xenotime Gδ is most plentiful, Gβ occurs in smaller proportion, Gζ is all but absent, and Sδ is quite absent. Yttrium from monazite contains Gβ and Gδ, with a fair proportion of the other constituents, Gβ is plentiful and the red is good. Yttrium from fluocerite is very similar to that from monazite, but Gα is weaker. Yttrium from hielmite is very rich in Gδ, has a fair quantity of Gα and Gβ, less of Gγ, no Sδ, and only a very faint trace of Gη. Yttrium from euxenite is almost identical with that from hielmite. Yttrium from cerite contains most Gζ and Gδ, less Gα and Gβ, only a trace of Gη, and a fair proportion of Sδ.

I have already mentioned how the key to these explanations was gained by an examination of the phosphorescent spectrum of M. de Marignac's Yα (now called by him gadolinium).

Referring to the diagram, it is seen that Yα is composed of the following band-forming bodies:—Gβ, Sδ, Gζ, together with a little samarium. Calling the samarium an impurity, it is thus seen that gadolinium is composed of at least three simpler bodies.

It is by a method of his own, differing from mine, that M. de Boisbaudran has obtained phosphorescent spectra of some of the rare earths. He takes the induction-spark between the surface of a strong and acid solution of the metallic chloride and a clean platinum wire a few millims. above it. The platinum wire is kept negative and the solution positive; it is then observed that in many cases a thin layer of fluorescent light is seen at the surface of the liquid. This layer gives a spectrum of nebulous bands. For the sake of brevity I will adopt M. de Boisbaudran's term, and call this process the *method of reversion* (the direction of the spark being reversed). As this method is entirely different to the one I adopt, it is not surprising that the results are also different. Experimenting in this way M. de Boisbaudran has obtained, among others, two bands (λ 573 and λ 543·2), which he considers are caused by two elements, named respectively Zα and Zβ, and which he considers new, at all events if we except terbium and possibly the elements of what was formerly called holmium. His method fails to show any spectrum in solutions of yttria which by my method give the yttria bands with the greatest brilliancy; while conversely his method shows a fluorescent spectrum in solutions of earths separated as widely as possible from yttria, chemically as well as spectroscopically. My experiments on both these methods tend to the conclusion that our bands are not due to the same cause, although M. de Boisbaudran's experiments have led him to the opposite conclusion. The band of Zβ (543) falls between the double green band Gβ, and the band of Zα (573) would come very near the citron line Gδ.

In the hands of a practised experimentalist like M. de Boisbaudran this method may give trustworthy indications, but I must confess that in my opinion the test is one beyond the range of practical analysis, owing to the enormous difficulty of getting the phenomena described by the discoverer. Unless the strength of spark, the concentration and acidity of solution, and the dispersion and magnifying power of the spectroscope bear a certain ratio one to the other, the observer is likely to fail in seeing a spectrum even in solutions of earths which contain considerable quantities of Zα and Zβ. In my own case I not only have had the advantage of personal instruction in Paris from M. de Boisbaudran himself in the best method of getting these reversion spectra, but on returning to London I brought with me some of the identical earths which give these spectra at their best. In spite of these advantages I have sometimes experimented off and on for weeks without being able to see more than a feeble glimmer of the bands described by M. de Boisbaudran.

Again, when everything is most favourable and the reversion bands are at their strongest, they are but a faint and hazy shadow of the brilliant lines given by the bombardment process. M. de Boisbaudran, speaking of the relative sensitiveness of our two methods, says that the bombardment process *in vacuo* is incomparably more delicate than his reversion test, and I estimate the relative sensitiveness of the two methods to be in the proportion of about 1 to 100.

You have probably anticipated in your minds a question which is likely to occur at this point of the inquiry. If such results have been obtained by submitting yttrium to this novel method of analysis, what will be the result of fractionating some other reputed element?

Yttrium, as I have explained, is an exceedingly stable molecular group, capable of acting as an element, just as calcium, for instance, acts as an element: to split up yttrium requires not only enormous time and material, but the existence of a test by means of which the constituents of yttrium are capable of recognition. Had we tests as delicate for the constituent molecular groups of calcium, this also might be resolved into simpler groupings. It is one thing, however, to find out means of separating bodies which we know to be distinct and have colour or spectrum reactions to guide us at every step; it is quite another thing to separate colourless bodies which are almost identical both in chemical reaction and atomic weight, especially if we have no suspicion that the body we are dealing with is a mixture.

(I mention calcium because it is one of several other elements which I have put through the fractionation mill. Many hundred operations have given me just sufficient encouragement to make me wish I had time to push this work to the end.)

One of the chief difficulties in the successful carrying out of an investigation in radiant-matter spectroscopy is the extraordinary delicacy of the test. This extreme sensitiveness is a drawback rather than a help. To the inexperienced eye 1 part of yttrium in 10,000 gives as good an indication as 1 part in 10, and by far the greater part of the chemical work undertaken in my hunt for spectrum-forming elements was performed upon material which later knowledge shows did not contain sufficient to respond to any known chemical test. It is as if the element sodium were to occur in ponderable quantity only in a few rare minerals seldom seen out of the collector's cabinet. With only the yellow line to guide, and seeing the brilliancy with which an imponderable trace of sodium in a mineral declares its presence in the spectrum, I venture to think that a chemist would have about as stiff a hunt before he caught his yellow line as I have had to bring my orange and citron bands to earth.

Chemistry, except in few instances, as water-analysis and the detection of poisons, where necessity has stimulated minute research, takes little account of "traces," and when an analysis adds up to 99·999, the odd 0·001 per cent. is conveniently put down to "impurities," "loss," or "errors of analysis." When, however, the 99·999 per cent. constitutes the impurity, and this exiguous 0·001 is the precious material to be extracted, and when, moreover, its chemistry is absolutely unknown, the difficulties of the problem become enormously enhanced. Insolubility as ordinarily understood is a fiction, and separation by precipitants is nearly impossible. A new chemistry has to be slowly built up, taking for data uncertain and deceptive indications, marred by the interfering power of mass in withdrawing soluble salts from a solution, and the solubility of nearly all precipitates when present in traces in water or in ammoniacal salts. What is here meant by "traces" will be better understood if I give an instance. After fifteen months' work I obtained the earth yttria in a state which most chemists would call absolutely pure, for it contained not more than 1 part of impurity (samaria) in 250,000 parts of yttria. But this one part in a quarter of a million profoundly altered the character of yttria from a radiant-matter-spectroscopic point of view, and the persistence of this very minute quantity of interfering impurity entailed another ten months' extra labour to eliminate these final "traces," and to ascertain the real reaction of yttria pure and simple.

The radiant-matter test applied to these phosphorescing bodies proves itself to be every day more and more valuable, and one of the most far-searching and trustworthy tools ever placed in the hands of the experimental chemist. It is an exquisitely delicate test, capable of being applied to bodies which have been approximately separated, but not yet completely isolated, by chemical means; its delicacy is unsurpassed even in the region of spectrum analysis; its economy is great, inasmuch as the test involves no destruction of material; and its convenience is such that any given specimen is always available for future reference. Likewise, the quantity of material is limited solely by the power of the human eye to see the body under examination. Beyond all these excellences is its trustworthiness. I should perhaps exceed the legitimate inference from experience were I to claim that this test is infallible; but this I may say—during the five years in which the test has been in daily use in my laboratory, I never once have been led to view its indications with suspicion. Anomalies and apparent contradictions have cropped up in plenty; but a little more experiment has always shown that the anomalies were but finger-posts pointing to fresh paths of discovery, and the contradictions were due to my own erroneous interpretation of the facts before me.

SCIENTIFIC SERIALS

Rendiconti del Reale Istituto Lombardo, July.—On some new substituted derivatives of benzine, by E. G. Körner. In order to complete the still defective aromatic series, the author has prepared a number of these derivatives, studying them in connection with the relative isomerous compounds. The list includes a hydrochlorate, $(B)HCl, H_2O$; a sulphate, $(B)2H_2SO_4$; orthoiodacetanilide, $C_6H_4I . NHC_2H_3O$; and nitro-orthobiiodobenzine, probably $C_6H_2 . I . I . H . NO_2$.—On the effects of the sulphate of copper against the parasites of the grape-vine, by Prof. Gaetano Cantani. It is shown that this remedy, which has already been successfully tried in France, should also he introduced in Italy, if not to supersede, at least jointly with, the milk of lime.—Chemical and experimental researches on human milk, by Prof. G. Sormani and T. Gigli. It appears from the authors' experiments that a mixed or normal diet yields far better results than an exclusively animal or vegetarian *régime*.—Meteorological observations made at the Brera Observatory, Milan, during the month of July.

Botanische Jahrbücher, von A. Engler, Siebenter Band, Heft iv.—Contributions to the morphology and classification of the Cyperaceæ, by Dr. F. Pax. The author regards the Cyperaceæ as reduced types of a series which is more advanced phylogenetically than the Juncaceæ. As regards their relations to the Gramineæ, he concludes that the affinity is not so direct that the one family could be derived from the other.—On the flower and inflorescence of the Centrolepidaceæ, by Prof. Dr. G. Hieronymus.—Contributions to the flora of the Cameroons, by A. Engler. A list of plants collected by Dr. Buchholz in the Cameroons in 1874, with descriptions of the new species.—On the origin of the weeds on arable land and waste places in Germany, part 1, by F. Hellwig.—Abstracts of important papers.

Heft v. opens with part 2 of the above paper by Dr. Hellwig. The first part is chiefly occupied with the general consideration of the subject, and lists of the plants in question; while the second contains a detailed account of the origin of the plants named in the foregoing lists.—The orchids collected by Dr. Naumann on the expedition of H.M.S. *Gazelle*, by F. Kränzlin. The volume closes with a valuable list of works published during 1885, on classificatory botany, &c. This, together with the frequent analyses of the more important of those papers which are published in languages not usually familiar to ordinary readers, greatly enhances the value of Dr. Engler's excellent serial.

Bericht über die Thätigkeit der botanischen Section der Schlesischen Gesellschaft, 1885, compiled by Prof. Dr. F. Cohn.—The Botanical Section of the Society held nine meetings during the year 1885, at which the following original papers were read:—Dr. Engler, on the vegetation of the German possessions in South Africa.—Dr. Pax, on the genus Acer.—Herr Limpricht, on the formation of pores in the cortex of the Sphagna.—Dr. Eidam, on an Entomophthoraceous fungus found on frogs' dung.—Dr. Schröter, on the mycological results of a journey to Norway.—Dr. Pax, on the morphology and classification of the Cyperaceæ.—Dr. Engler, on the family of the Typhaceæ.—The report closes with a statement of the results of the investigation of the Phanerogamic flora of the district in 1885, arranged by R. von Uechtritz.

Beiträge zur Biologie der Pflanzen, von Dr. F. Cohn, Vierter Band, Zweites Heft.—Investigations on the tendrils of the *Cucurbitaceæ*, by Dr. Otto Müller, of Breslau (3 plates). The author concludes, chiefly on anatomical grounds, that the irritable part of the tendril of the Cucurbitaceæ is of foliar nature.—Investigations of the *Flagellatæ*, by Dr. Arthur Seligo (1 plate).—*Basidiobolus*, a new genus of the *Entomophthoraceæ*, by Dr. Ed. Eidam (4 plates). The author regards the resting spores of this genus as true zygospores, though the gametes are of unequal size, and expresses the opinion that the *Entomophthoreæ* find their natural place in the *Zygomycetes*, as directly related to the *Mucorini*.

SOCIETIES AND ACADEMIES

SYDNEY

Royal Society of New South Wales, August 4.—Ch. Rolleston, President, in the chair.—The Society's Medal and Prize of 25*l.* was presented to Mr. S. Herbert Cox, F.C.S., F.G.S., for his prize essay on "The Tin Deposits of New South Wales." The principal deposits occur in New England as impregnations, segregation veins, and lodes in granite, also as gash veins in Silurian slates, and as a network of veins or stockwork in haplite. The granitic eruption occurred not later than Carboniferous times, and no sedimentary strata appear to have been deposited until the Tertiary period, when the leads of alluvial tin were formed, together with their associated gravels. Denudation on an enormous scale has gone on, and the Silurian slates which rest on the granites have only been preserved as outlying patches included in folds in the granite. Dykes of feldspar and quartz porphyry traverse both the granite and slates, but the date of this eruption is probably Tertiary, although evidence appears to point out that this acidic only preceded the ensuing basaltic eruption by a short time. The more fluid basalt flowed for considerable distances, frequently burying the gravels of the river-beds with the tin they contained, and preserving these "deep leads" from subsequent denudation. True lodes appear to be rare, but some remarkable impregnated areas exist in greisen; "segregation" veins of small size are found in the granite, and in the slate "gash" veins up to 4 inches in width occur, but these are certainly not true lodes. Fortunately, wolfram occurs in separate veins from the tin; copper and iron pyrites, fluor-spar, tourmaline, white mica, and topaz are common; beryl forms a rock with quartz, through which tinstone is impregnated. In the alluvial deposits, tinstone is found associated with diamonds, sapphires, zircons, &c. The greater quantity of the tinstone hitherto raised has been from the alluvial, and the "deep leads" which are still being worked, and will probably be greatly developed in the future, closely correspond in their course with the shallow ones. They are worked to depths of 140 to 180 feet, and are frequently found below solid floes of basalt. Very good crushing and smelting plants have been erected, and although the conditions of the district vary greatly in different parts, it may be taken as certain that a yield of 5 per cent. tin in lodes, and from ½ to 1 cwt. per cubic yard in deep alluvial deposits, pays for extraction. The total output of tin between 1872 and 1883 is 64 794 tons of ingots and 13·268 tons of black tin.—A paper by the late Rev. P.